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NOTES ON THE OCCURRENCE OF A BLACK BITUMINOUS SHALE NEAR PALO, LINN COUNTY, IOWA

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The rock formations of Linn county belong to the Devonian period. During an examination, with the possible exploitation of Devonian rock as a source of Portland Cement, Mr. A. S. Hammond and others of Cedar Rapids, Iowa, encountered in an excavation near Palo, Iowa, a black, bituminous shale. The shale is fine-grained and in places very bituminous. The layers vary in thickness from mere seams along bedding planes to an inch in thickness where exposed in the excavation, and lie at various depths below the surface in the valley of Little Bear creek. The presence of an old shaft sunk by farmers with the possible finding of coal in view, led to further exploration, of which this is a report.

The shale seems to be a form of coal and would probably be classed as a lignite, but has been characterized by a dealer as the type known as "bone" coal. It burns rather readily but has a very low heat content. Closely associated with the black shale is a hard, compact blue shale, containing an abundance of iron pyrites. The pyrites occurs as nodules. In places nodules three inches in width and six inches in length are common. This pyrites probably represents the replacement of a limestone or of a shale.

Some of the peculiarities of the shale noted in the few specimens at hand include a network of small but well developed ridges which appear very much like a small piece of the bark of a Lepidodendron which has been partly replaced by iron pyrites. The structure is quite small, however, to be classed as representing more than a small fragment. Another structure consists of a series of concentric rings for which no explanation is as yet offered. The rings look not unlike the concentric rings of a tree, but are very fine, the diameter of the structure being no more than one-half inch. Another characteristic feature occurring throughout the shale is the presence of slickensides, which occur at rather regular intervals and give the appearance of cleavage faces. The slickensides were especially noticeable near the contact with the heavy blue shale. In places, there are fibrous substances which seem to be plant remains and have the appearance of Sigillaria.

The thin seams of coal may represent the former fibrous tissue of plants.

A quantity of the shale, when it was crushed and placed in a small retort and heated for fifteen minutes and the gases collected in a test tube, produced about 10 cc. of a heavy black crude oil. This represents a very small portion of the gases which were given off, as the test tube had no cork in it and much of the gas escaped. In passing from the tube the gases were a heavy brown color and burned very readily. In the fifteen minutes of heating slightly more than one-third of the shale was given off as gas. The following figures show the result of heating:

343.1 grams—weight of retort empty.

374.5 grams—weight of retort with shale.

365.5 grams—weight of retort after heating and distilling.

Total shale in retort before heating—31.4 grams.

Total shale in retort after heating—22.4 grams.

Loss in weight in shale after fifteen minutes of heating—9.0 grams.

The following is the log of the shaft sunk in line with the old shaft on top of hill, thirty yards distant. The shaft was 3½ by 4½ feet and narrowed downward. This shaft occurs at the edge of a pond on a small terrace along Little Bear creek.

		Feet
11.	Gravelly, yellow clay with a few small boulders	2½
10.	Black shale. Fragments of coal occur with a blue clay. Small fragments of Lepidodendron and Sigillaria	1
9.	Blue clay (hardpan type)	1
8.	Clay, dark blue, almost black. Contains nodules of iron pyrites. Seams of "bone" coal give the clay the appearance of stratification	2½
7.	Shale, black, glossy	½
6.	Clay, black, very hard. Some pyrites	1½
5.	Thin layers of black shale running through clay. The brown shale weathers to a white chalky shale on exposure. Distinct odor of gas in hole	½
4.	Streaks of black shale running across shaft. A layer of black "bone" coal 1 inch thick with shale, very black and coal-like in appearance. Much pyrites.	½
3.	Clay blue to brown, very hard with occassional nodules of iron Gas odor absent.	2½
2.	Clay, blue to brown with streaks of black shale which appears to be slacked	4
1.	Pockets of "bone" coal with black shale.	2
	Below this point the shale grades into a concretionary limestone and then into the limestone proper.	
	Total	18½

Numerous small ponds appear along the terrace of Little Bear creek, usually 100 to 150 feet from the creek. This seems to indicate that the blue clay or hard pan is quite impervious to water and underlies the entire valley for a considerable distance up and down the stream. The clay was encountered in numerous borings along the valley. The black shale occurs with the clay in most of the borings. In all cases the shale lies approximately thirty-five feet below the top of the valley wall on the east side of Little Bear creek. On the west side it lies approximately forty-five feet below the top of the valley wall.

The iron pyrites weathers out of the clay and shale very rapidly when it is exposed on the dump. Further examination will be made of the possible fossil plants and of the stratigraphic position in the Devonian which the shale occupies. It may be possible to correlate the shale with a dark shale reported at Independence, Iowa, by Samuel Calvin.[1] The shale at Independence is very similar to that near Palo. Both contain fragmental plant remains suggestive of the Lepidodendrons and Sigillarias and in all cases the form only has been preserved, and that by iron pyrite, which has replaced the original plant fibres and stems.

So far no fossilized animal remains have been found at Palo. At Independence a number of brachiopods were reported by Calvin.[2] With the finding of fossils and the determination of the position of the shale in relation to the Devonian, correlation with the Independence dark shale will be possible.

Doctor Calvin mentions in his report the prospecting for coal at various places in the Devonian of Iowa, and concludes that this dark shale containing fragments of coal was the one prospected. With the known occurrence of a dark shale at Palo it is possible to account for the prospecting at Marion, Iowa, a number of years ago.

Further investigation will be undertaken at a later date.

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1 Some dark shale recently discovered below the Devonian limestones, at Independence, Iowa, with a notice of its fossils and description of new species. Bulletin U. S. Geol. and Geog. Surv. Terr., Vol. IV, pp. 725-730, Washington, 1878.

2 Ibid.